SUPPLEMENT.

The Mining Journal,

RAILWAY AND COMMERCIAL GAZETTE:

FORMING A COMPLETE RECORD OF THE PROCEEDINGS OF ALL PUBLIC COMPANIES.

No. 1467.—Vol. XXXIII.] LONDON, SATURDAY, OCTOBER 3, 1863. [WITH JOURNAL] STAMPED.... SIXPENCE. UNSTAMPED. FIVEPENCE.

SOUTH WALES INSTITUTE OF ENGINEERS.

The annual general meeting of the members of this valuable, and, we are glad to learn, flourishing Institute took place in the Theatre of the Royal Institution, Swansea, on Saturday last. The walls were hung with plans, sections, and drawings explanatory of the various papers to be discussed, whilst there were several samples of iron made with different kinds of coal exhibited on the table. The chair was taken by the President, Mr. Thomas Evans, F.G.S., Government Inspector of Coal Mines for the South Wales division, and amongst those present we noticed Messrs. Lionel Brough, of Clifton, Government Inspector for the Bristol and West of England district; Messrs. Alexander Bassett, C.E. (Cardiff), Huxham (Swansea), Thos. Walters (Swansea), B. Kirkhouse, R. Bedlington, John Cox, Josiah Richards, Windsor Richards, C. Lane, M. Moxham, W. R. Jones, Matthew Truran, M. Brown, J. Nasmyth, J. Allen, T. Nixon (Cardiff), G. Birbeck, J. Glassbrook (Swansea), Thomas Glassbrook, jun. (Swansea), John Williams (Aberdare), Dr. Williams (Swansea), and a large number of others connected with the iron and coal trades of South Wales.

The President, in opening the proceedings, said:—Six years have passed away since the promoters of the South Wales Institute of Engineers met together at Merthyr, and held their first meeting in that great centre of mining and manufacturing industry. We were but few in number, inexperienced in the conduct of such matters, and labouring under innumerable difficulties, the overcoming of which nothing but experience can teach and bring about. Since then we have gone on, and it is a source of much congratulation to find our numbers have increased even beyond the expectations of the most sanguine; and now I may fairly be allowed to designate the Institute a most important body. But, gentlemen, with all our success, unhappily there is a melancholy duty to perform. Death has been amongst us. [illegible]

[illegible]

The writer says:—"Acting upon the suggestions of Mr. Hedley, Inspector of Mines for the midland counties, the following observations are submitted in reference to the machinery now in operation at West Ardsley Colliery, near Leeds. The cutting of coal by machinery has been discussed at the meetings of the South Wales Institute, and, as there are diversities of opinion as to the practicability of so employing machinery with economy, the description of our machine, and statement of results of working, may throw some light upon the subject. [illegible]

pipes have been fixed four months without displacement or repairs; nor have we any difficulty with the India rubber tubing, which bears the pressure exceedingly well—in fact, we have no trouble either with this or the iron piping. The plate represent the machine. It is constructed of angle iron, and is about 4 ft. long, 3 ft. 6 in. high, and 2 ft. 6 in. wide. The weight is about 14 cwts., including the small air-engine to work it. It is mounted on wheels, and is readily moved forward and backward by the attendant. The cylinder of the engine is 5 in. diameter, and 12-in stroke, and the piston is connected with a crank attached to the vertical shaft, which carries the pick fixed in the socket. The pick is made very strong, and with a chisel point, to suit the work at our colliery, and can be readily removed in a few minutes. No doubt the form of the pick point must be varied with the material holed in. The pick socket is fitted to the shaft, for adjustment to any height between the floor and roof of the seam, so that the holing can be effected at an intermediate point. The motion of the pick follows that of the human action, and either a double or single headed pick may be used, the former, however, takes up more width in working than the latter. The strength must be proportioned to the work, and the length of the head to the depth of the holing. We employ double picks, with a head 36 in. long. A width of about 3 ft. is maintained between the front row props and the stall face for the passage of the machine in holing. The road is formed with strong rails, so as to avoid springing when the machine is in action. The seam of coal at our colliery has an inclination of about 2 in. to the yard; a strong bind or shale roof is about 4 ft. 2 in. thick, with two partings, or bands, in the middle, thus:—

Upper coal....................	2 ft. 2 in.
Parting	0 ft. 4 in.
Coal..........................	0 ft. 4 in.
Parting	0 ft. 4 in.
Bottom Coal....	1 in. 0 ft.=4 ft. 2 in.

The system of working is by long wall; but until recently we have only had stalls of 40 to 45 yards long open, which has been a considerable disadvantage in applying the machine, as we find that one machine holes 100 yards per shift of 8 hours 3 ft. under. We have, however, had one machine in operation on this length, and the results will hereafter be noticed. We hole in the middle piece of coal between the two partings, or bands, about 2 ft. 6 in. from the roof, and 1 ft. 4 in. from the floor. The coal in which we hole is tender, but contains a large quantity of hard pyrites, which is destructive to the points of the hand pick; but from the more solid form and size of the machine tool, there is much less difficulty in making it stand the work, and the cost of repairs is considerably less, being about one-eight the cost of hand tools. The holing (3 ft. under) is accomplished in three courses or lifts—*i.e.*, the machine is passed thrice along the face to hole this distance under—the first holing is 16 to 18 in. wide, the second 10 to 11 in., and the third 8 to 10 in. deep, a change in the cutting arm or pick being necessary at the end of each course. If required, a machine can be constructed which will hole 12 in. deeper, but we find the above to be the depth most conveniently holed. When a course of lift is finished, the machine is taken back to the starting point for the next lift, which occupies about two or three minutes, the only change being the cutting arm or pick. The time occupied in cutting the three lifts averages about one minute for every lineal foot of 3 ft. deep. In strong coal this depth can be worked by cutting away only 3 to 4 in. in height at the face. A man and a boy attend the machine, and a man looks after the road and propping of the stall face. In our seam the upper parting band falls down after the first course is holed, and this necessitated the removal of more refuse than would occur in the ordinary work. The boy clears away the refuse and greases the machinery. The attendant sits upon the seat of the machine, and watches and regulates the speed of the pick, which works about 70 strokes per minute. A light is fixed in front of the machine to show the pick, and at each stroke he moves the machine forward 1⅛ to 2 in., by means of the wheel. The labour in handling the machine is not difficult, neither is much physical exertion required. A little of the "head" being more material than "muscle," The attendants perform the work with facility, and certainly have the easiest posts in the mine. The machinery is very simple, and little liable to derangement; nor are the working casualties more numerous than those of working any other machinery. Experience will, no doubt, suggest improvements in some of the details; but the machine now works in a very satisfactory manner, and the results are much better than we originally anticipated. The following are the results of working one machine six days of eight hours each, and including stoppages:—618 yards were holed 3 ft. under, which is more than 100 yards per day. The cost of labour attending machine, removing holing refuse, and attending surface engine, is 1½d. per ton on coals raised. One penny per ton will amply cover wear and tear of machinery, interest, and redemption of capital on a daily get of 500 tons. The produce of large coal is also satisfactory, as the following figures show:—

	Got by Machine.	By Manual Labour.
Best Coal	27·78	17·70
Seconds ditto	36·90	46·00
Small ditto........................	35·62=100	36·30=100

The benefit in produce by holing with the machine is equal to 2½d. per ton on the gross get. Our coal is very jointy, and, consequently, the proportion of small is in excess. The holing being in partings of the seam, the small is made in breaking up the coal. Where the holing is in strong coal, the benefit by using the machine will be much greater, in many cases equal to 4d. or 5d. per ton on the gross produce. The cost of holing by hand is 7d. per ton; the advantage, therefore, by the machine over manual labour is 4½ per ton, and in produce 2½d., a total of 7d. per ton. The trial of machinery for heading has not yet been made, but we are sanguine of results equally as satisfactory as these. We are preparing machines for heading, and which will shortly be in operation. The sanitary aspect of this question cannot be overlooked. The diminution in the number of men and burning lamps must render the atmosphere of the mine less vitiated. The discharge of a considerable quantity of pure air into the working places, in addition to the ventilation, will impart a more healthy condition to the atmosphere. The command of a powerful stream of air under a pressure of 50 lbs. per square inch will be useful in removing accumulations of explosive gas, which might not be removed by the ordinary current of air. I am informed that upwards of 40 per cent. of the loss of life in coal mines arises from falls of coal and roof. The introduction of machinery will reduce the number of persons exposed to these casualties at least by one-half, and, consequently, a considerable saving in life will result. Having in view the facility for opening new works, and the ready means at all times for an increased power of production under sudden demand, caused by unusual seasons or other circumstances, and when the prices of coal are more profitable, the increased yield of large coal in the diminished quantity broken in hewing when compared with manual labour—all these and some other reasons warrant me in expressing a very confident opinion in favour of the introduction of machinery to coal cutting. The cost of compressed air power is undoubtedly great as compared with that of steam; but, nevertheless, when its advantages are put into the scale against the disadvantages of the old system, that cost becomes insignificant and immaterial.

Mr. Lionel Brough said that there could be no doubt in the world that, under the circumstances which now prevailed, a coal-cutting machine would be a most desirable thing; but the question then arose what sort of one. He believed the best one which had been exhibited up to the present moment was that of Preece's, which appeared to be a kind of mechanical mandril or pick. Now, how far such could be applied to all sorts of seams is a question of great moment, and one worthy the consideration of engineers and colliers generally. In very inclined stratifications he could hardly conceive how such a machine would suit. Again, he had heard it stated that so terrible was the blow struck by this powerful mandril, impelled by the force of compressed air, that some of the strokes produced streams of fire, probably by striking against pyrites or particles of siliceous matter. Now, if streams of fire, or even sparks, were produced, he (Mr. Brough) should not like to apply the machine in the fiery seams of South Wales. Again, they did not at present know how to apply the engine to nicking or cutting; if the machine would only hole he thought they may as well be without it. For his own part, he could only see that the machine would be productive of good when applied to long work in stalls. He apprehended that a piece of moving machinery would occupy so much space as to interfere with the speed and dispatch of removal of coal. He regretted to say that when in Newcastle, at the recent meeting of the British Association, he was unable to attend the section where the discussion was carried on about these coal-cutting machines; therefore, he could not speak with any very great degree of authority thereon, and, in opening the discussion, and making these few crude observations, he did so in the hope that something would be elicited from other gentlemen who knew more about the matter than himself. He saw Mr. Bedlington present, who was a most practical man, and, being the manager of large mines, was, doubtless, desirous of substituting machine labour for human labour, if such could be profitably done. He should like to hear Mr. Bedlington's opinion, as, doubtless, he had considered it well.

Mr. Bedlington said they had seen by the description of work which this machine was capable of doing that it was simply holing; he did not think it had been stated by anyone that cutting was done as well. Now, they all knew that holing was but a very small part of a collier's labour, and was very little required, especially in long work, where there was a good deal of pressure on the face of the coal. Now, if the machine was for holing only, it would be but of very little assistance indeed, for, even with the machine in work, they must have a man to block down the coal, to fill the coal, and to cart the rubbish, just as before, so that there would be but very little assistance given in cutting and filling the coal. Then, again, they would have to be constantly removing the machine from one stall to another, and he did not know how many machines they would not require in an extensive colliery, so as to be of any service. So far, therefore, as he had read the descriptions of the various machines, he thought there was very little to be got out of them, so far as the saving of labour was concerned, and that, after all, was the great item. The holing, upon which so great stress had been laid, was, as he had said before, only a very small part of the colliers' work. They would have to leave a great deal of room open where this machine was at work, and there would be very great difficulty in keeping up the roof where they came to a fault. [illegible]

the machine would do nothing but hole. He should like to know what was the cost of the machine per ton?—Mr. BIRBECK: About 2d. per ton.

Mr. BEDLINGTON: The question then now is does the holing cost more than that?

Mr. BIRBECK: You should remember that the percentage of large coal is very much increased by the machine.—This closed the discussion.

DESCRIPTION OF A MODE ADOPTED OF SINKING A PIT THROUGH QUICKSAND.

The SECRETARY then read Mr. JOHN GLASSBROOK's (of Morriston) paper on this subject. The writer stated that on the east side of the River Tawe, about three miles to the north of Swansea, there is a large piece of land of at least 1000 acres, which contains on an average about 60 feet of clay, quicksand, and alluvial soil. It is supposed that this was at one time a lake, as they found on sinking old trees, &c., at a depth of about 20 ft. below the surface. The whole of the veins of coal lie underneath this, and many attempts have been made to win the coal by sinking in different parts of the ground. About 20 years ago the Swansea Coal Company made an attempt in the Upper Forest, but did not succeed in reaching the rock, after incurring very great expense. Iron cylinders of great length and diameter were used, and very powerful machinery erected—in fact, no expense was spared, but did not succeed. A few years ago himself (Mr. Glassbrook) and partner made another trial, but failed; they adopted the old plan of timber and lagging, but they could not get down more than about 40 ft. They then tried another plan, which succeeded. They drove down four piles, shoed and steeled at the points, which were 48 ft. long and 11 in. square, at each angle of the pit, and drove down smaller piles between them, which were tonged with iron in the joints. They then commenced excavating the ground, and to secure the piles we placed cross timbers in iron sockets, secured in the angle piles. "As we proceeded with the sinking we kept driving the small piles short distances before the sinkers, to prevent the sand from running in. Before we reached the rock we erected a 14-in. and a 11-in. pump working 4-ft. stroke, and making 17 revolutions per minute, and by this means succeeded in reaching the rock, and then we tubbed it with cast-iron. The ground about the pit was disturbed, and we were obliged to drive some piles to get a foundation for the pumping-engines. We also put the bob to work under the cylinder, so that the sill plate, which is under the main gudgeon, is on a level with the surface, so that in case of breakage it should not fall down the pit."

Mr. BROWN said that the plan adopted by Mr. Glassbrook was, no doubt, very well for the description of work to be done, but he very much questioned whether the method would answer in the North of England, where the depth was so much greater, and where the sand was so much more powerful. He thought Mr. Glassbrook's plan impracticable in the North.——Mr. GLASSBROOK said that he himself would not advise this plan being adopted if there were a greater depth than 40 ft. They might succeed with 60 ft., if they used longer and stronger timber, but he should try another plan if he were going down to a depth of 60 feet.

Mr. BROWN said he had had some experience in these matters. Some time ago he had to sink through 32 yards 0 ft. 6 in. of quicksand under a fish-bed, with 2500 gallons of water per minute, and with all these things he put it through in seven weeks.

Mr. BROUGH proposed a vote of thanks to Mr. Glassbrook, for his able and clearly-defined paper.——Mr. BASSETT seconded the resolution, and remarked that Mr. Glassbrook had exercised a great deal of care and ability in the work of sinking, and he was glad to find he had at last succeeded.——The resolution was then carried, the paper being ordered to be printed in the society's Transactions.

ON SURFACE CONDENSATION, AND THE USE OF DISTILLED WATER IN BOILERS.

BY MR. TURNER, OF LANSAMLET, SWANSEA.

This was an exceedingly voluminous and able paper, in which the writer, in the first place, glanced at the early history and use of boiler condensers, both surface and jet condensation, the latter of which was discovered by mere accident. A more perfect system of condensation was generally required, more especially in marine-engines, and there were but few engineers of eminence who had not turned their attention to the subject. A large quantity of water was not so much needed in surface condensers as purity of water,—the effectiveness of the condensers depending on purity of water, the rapidity of circulation, and the force with which it impinges. After glancing at the various modes which had been patented by Cartwright, Hall (of Nottingham), Spencer, &c., the writer observed that some of the steamers of the Peninsular and Oriental Steam Navigation Company had recently adopted his patent, and in marine-boilers his plan was usually found to double the quantity of steam per horse-power; and boilers of half the size with surface condensers would do for engines of unaltered size. The use of distilled water was advocated, the water generally used in boilers containing so many impurities as to cause fur, incrustation, and even cracking of plates. Mr. Turner exhibited a piece of boiler-plate completely honeycombed, the effects of water containing corrosive acids.—No discussion took place upon this paper, the PRESIDENT stating that the subject was one of such great importance that they had better defer the discussion until the paper had been printed, and a copy in the hands of each member of the Institute.

Upon the proposition of Mr. COX, seconded by Mr. NIXON, a cordial vote of thanks was awarded to Mr. Turner for his valuable paper.

The PRESIDENT then read a letter which he had received from Mr. Adams, who was unable to attend the meeting, but had forwarded some samples of iron made with coal from the eastern outcrop of the South Wales basin. He (the President) alluded to this matter now, because in a paper given by Mr. Child at the last meeting something was said about the manufacture of iron from the raw coal, and it was said that "in the eastern part of the South Wales coal field the coals were too bituminous—that is, of too coking a nature—to be used raw in the blast-furnace." Mr. Adams had sent them a practical reply to that statement by forwarding them samples of iron made from the rock vein coal. He (the President) admitted that he was somewhat out of order in alluding to this matter now, but it had created a good deal of interest and discussion at their last meeting.

Mr. JONES, of Dowlais, said that he was not aware that Mr. Child had contended that the iron would be deteriorated in quality by the use of the raw coal.

The PRESIDENT: He said it could not be made, but Mr. Adams has proved to the contrary.—Mr. RICHARDS: The object of Mr. Adams sending these samples of iron down to the meeting was simply to prove that iron, and good iron too, could be made from the raw coal of the east crop.

Mr. COX said that when Mr. Adams asked him to take charge of the parcel, he said that his object in sending it was to prove that what he had stated at the last meeting of the Institute was correct—that iron could be made from the raw coal of the district.

Mr. RICHARDS said the samples produced had been manufactured under his supervision, and he had watched the working of the furnace very carefully, and great care had been taken in making the samples. Iron had been made in various ways—with coke, with coke mixed, and raw coal. There had been no irregularity whatever in the working of the furnace. There had been no difficulty in using raw coal in Abersychan. They were particularly anxious to ascertain the fact of iron being made from the raw coal, and the fact now lay before them. He assured them that there was no difficulty in using this coal, which was the rock coal, and he was surprised to see it working so well, and coming out of the furnace so regularly.

The PRESIDENT said it was not only Mr. Child but several other gentlemen who were of opinion that the coal of the eastern basin was not adapted for smelting purposes.

This closed the discussion, and the SECRETAY next read an interesting paper on

LONG WORK.

BY MR. JOHN WILLIAMS.

The writer stated that the object of the paper was more to place on record his experience of the long work system, as carried out in the Letty-Shenkin Colliery, Aberdare, than as a paper on the long wall as applicable to the steam coal of Aberdare generally. Up to the year 1858, as they were all probably aware, the whole of the coal of the Aberdare district was worked entirely upon the pillar and stall system. In consequence, however, of the great loss of marketable coal by this system—the great quantity of small coal made, and the percentage of coal left in the ground—the proprietors turned their attention to another system, and now the long wall system was almost universally adopted in all veins under 6 feet. From his experience in the Letty-Shenkin Colliery, he had no hesitation in saying that the long wall system was the safest and most economical system yet introduced. Since the introduction of the long wall system, the keeping of the air-way had been reduced to the minimum, only one waste-man being required, where they were getting at the rate of 200 tons per day. By the long wall system the whole of the coal was taken away, and now in a marketable condition. They had worked about 50 acres by the long wall system, and the writer of the paper believed and felt satisfied that they would have had to have worked 100 acres by the pillar and stall system to have obtained the same amount of coal. By the long wall system the coal was obtained large and fresh, and contained a very much larger quantity of gas, which was so necessary for the purpose of generating steam. The men at first objected to the principle, but now, having seen the advantages of the new system, there would be as many, if not more, objections raised to going back to the old system of pillar and stall. Notwithstanding the manifold advantages, however, the writer was of opinion that in very large works the introduction of the long wall system was not practical, or in works where the roof was not sufficiently tenacious to keep the whole up together. In a word, he would not advise this system being adopted in seams above 6 ft. in thickness; but for the Aberdare district, where the whole of the seams were 6 ft. and under, he had no hesitation in saying that the long wall system was the safest, cheapest, and most profitable yet introduced.

The PRESIDENT said he believed they were all of opinion that if the roof was strong and good the long wall system was the best.

Mr. COX then moved, and Mr. BEDLINGTON seconded, a vote of thanks to Mr. Williams for his paper, which was ordered to be printed for discussion at the next meeting.

ON COAL AND IRONSTONE MINING IN SCOTLAND.

BY MR. RALPH MOORE.

This was a long statistical treatise relative to the make and progress of coal and iron mining in Scotland, the author appending the following statistics as to the rapid growth of the iron manufacture in that part of the United Kingdom:—"In Scotland, the make of iron in 1760 was 1500 tons, and in the year 1788 the same amount. In 1796, it increased to 18,640 tons; in 1806, to 20,240 tons; in 1820 it declined to 20,000 tons; in 1830 it increased to 37,500 tons; in 1840 it was 239,000 tons; in 1850 it was 595,000 tons; whilst in 1860 the make was 1,000,000 tons. Of the total make in 1859 of 950,000 tons, Lanarkshire produced 575,000 tons; Ayrshire, 261,000 tons; Fifeshire, 45,500 tons; Stirlingshire, 38,000 tons; Linlithgowshire, 23,000 tons, and Haddingtonshire, 8000 tons.

A cordial vote of thanks was awarded to Mr. Moore for his paper, the discussion thereon being adjourned until after the printing of the paper.

The PRESIDENT said that this closed the business of the day, but they should not separate without proposing a vote of thanks to the Council of the Royal Institution of South Wales for the use of the Theatre, which had been so kindly granted them that day.—Carried unanimously.

Mr. BROUGH said there was still a duty of a most pleasing nature to perform, and that was awarding a vote of thanks to their worthy and most excellent President for the year. Mr. Evans had been most assiduous and zealous in the discharge of the important duties of his office. He had carefully watched over the interests of the Institution, and had performed the duties in a manner far superior to any of his predecessors. He regretted that one of their constitutional laws prevented their having a president for two successive years—otherwise he (Mr. Brough) should certainly propose the re-election of Mr. Evans.—Mr. ALEXANDER BASSETT seconded the proposition of Mr. Brough, and the resolution was then carried with enthusiasm.

Mr. EVANS (the President) briefly responded. Whilst he had the honour of being President he had honestly endeavoured to do the best to promote the interests and welfare of the Institution; and in retiring from the office of Chairman he should still take the deepest interest in the association, believing, as he did, it was productive of the greatest benefit.

THE DINNER.

The members of the Institute dined together at the Mackworth Arms, on Saturday evening. Mr. T. EVANS presided, supported by the Mayor of Swansea (Mr. E. M. RICHARDS). Most of the gentlemen who attended at the general meeting were present.

The health of Her Majesty having been drunk with due enthusiasm,

The CHAIRMAN proposed the "Corporation and Town of Swansea." The objects which the South Wales Institute of Engineers sought to advance were so closely connected with the prosperity of a trading town like Swansea, that it was not necessary for him to use many words to induce them to drink the toast he had given with great cordiality. On all occasions when they had met in this town they had been honoured with the presence of the chief magistrate. He was happy to see his friend—if he might be allowed to call him so—the present worthy Mayor with them that day. (Hear, hear.) He had great pleasure in coupling his name with the toast.

The toast was drunk with great cordiality.

The MAYOR said he was sure he might say, on behalf of the Corporation of Swansea, that they responded most heartily to the sentiment which his friend the Chairman had expressed, that the interests of the town were intimately bound up with the progress of mechanical engineering in the country. Years had gone by since Swansea was a fashionable watering place; and its inhabitants were accustomed to welcome their friends from Merthyr and Aberdare—if Aberdare was known then—("Oh, oh!")—at all events from what was generally known as "the hills"—(hear)—as visitors to the seaside. That day had gone by. His friend Mr. Williams seemed to think that it was rather the reverse of a compliment to Aberdare to question whether it were known at that early period—(laughter)—but he (the Mayor) could at any rate safely say this—that those times being past, the people of Swansea welcomed their friends none the less heartily because they now received coals from Aberdare instead of visitors. Speaking seriously, he thought he might truly say that during the last 10 years Swansea had shown itself quite ready to do everything that could reasonably be expected of her for developing that trade, not only of her own immediate neighbourhood, but of Aberdare, Merthyr, and the hills generally. (Hear, hear.) He recollected some few weeks ago being brought into communication with a gentleman who formerly held the post of harbour-master at Swansea, and he had shown him a letter written by a gentleman of some influence, in which he expressed the opinion that there was no necessity for deepening the entrance to the harbour, and developing what was then known as Port Tennant, because it was better for the Swansea people generally to be satisfied with the coal which was obtained in their immediate neighbourhood—(laughter)—and that they should rather consider their interests as being bound up with the trade which existed within the area of five or six miles of the town, than attempt to bring anything from the eastward. (Laughter.) Those days were, as he had said, now past, and he thought he was not egotistical when he said that the Swansea people were ready to give every facility for receiving the coals of his friend Mr. Williams, and not only coal but iron. (Hear, hear.) No doubt Swansea, like most other towns, made now and then what came to be considered by those who followed as great mistakes. But it must be remembered that what was done by the Corporation of Swansea had been done by them in the character of public trustees, and that they had no funds on which to draw except those which had been entrusted to them by the confidence reposed in them by the public generally. He hoped, however, that they would be able from time to time to make such improvements as would considerably increase the trade of the port, and afford their friends from Merthyr and Aberdare every facility for bring in their coal and iron. To the best of his belief the Swansea people endeavoured to do their duty honourably and faithfully; and he was sure that the gentleman who followed him in the office which he then had the honour to hold would welcome that Institute to the town none less heartily than he himself did. He believed it had been usual for the Mayor for the time being, when he had the pleasure of being present with them, to propose "Success to the South Wales Institute of Engineers." He now did so very heartily, and had much pleasure in coupling with the toast the name of his friend Mr. Evans. It would be impertinent for him in his presence to say much that he would otherwise desire to say in his praise, especially as there were many gentlemen then present who were better able to appreciate the good offices which he had performed to the Institute than he himself was. But he had had a little experience of his services in one or two departments, and he must say that he thought he was worthy of holding the office he had done during the last twelvemonths, and that he was sure his conduct in it would have gained him the esteem of them all. (Applause.)

Mr. EVANS, in responding, said that any little service which he had been able to render to the Institute had been given most willingly; indeed, holding the office which he did in the district, and feeling the advantages in many ways which the Institute was likely to confer, it was no more than his plain duty to give it all the assistance in his power. He thought it had done a considerable good already, and that it was likely to do much more.

The CHAIRMAN then proposed the health of the newly-appointed President of the Institute, Mr. Bassett, which was drunk with great cordiality.

Mr. BASSETT having, as President, taken his seat at the head of the table, briefly responded. He said he felt that, in accepting the office which they had been kind enough to confer upon him, he was undertaking duties of no ordinary kind. When he considered that he was associated with gentlemen of great scientific attainments and high practical knowledge, he felt somewhat diffident in taking such a position. At the same time he felt that it would be an ill compliment to the Institute if he had refused it—(hear, hear)—and he could only say that he would do his best to further their interests, and that they must kindly overlook his imperfections. (Applause.)

Mr. COX next gave the "Town and Coal Trade of South Wales." As they were almost all engaged in one or other of these trades, it might almost seem as if he were asking them to drink their own healths. But the toast was given rather in order that they might have an opportunity of paying a tribute to those gentlemen whose enterprise had originated the works, than as a compliment to those who were engaged in connection with them. It was impossible for anyone to go through the country, as he had gone that day, and observe the enormous outlay which had been made in ironworks and collieries—it was impossible to observe how gentlemen had invested what would have been a prince's income in ironworks, or a noble's dowry in collieries—without feeling for those gentlemen great admiration and pride; admiration at the enterprise and pluck which they had shown, and pride that they could consider themselves united with them as members of the same great nation. The virtues which they had so largely displayed were those which had been the foundation of the country's prosperity and greatness. They were men of whom any nation might be justly proud. (Hear, hear.) Theirs was that untiring but unobtrusive virtue which had laid the foundation like a rock of adamant, which supported the great superstructure of England's glory and England's fame. (Loud cheers.) He coupled with the toast the names of Mr. Gwilym Williams and Mr. J. Glassbrook.

Mr. G. WILLIAMS returned thanks for the honour of having his name mentioned in connection with that Institute, for he had been much gratified in listening to some of the papers that had been read that morning, and the able discussions which followed. He had no doubt the Institute would do good to the community at large, and particularly to the mining interest. He was but a young collier himself, but intended at a future time to do something more in the way of mining. In connection with the coal trade, he was glad there was shortly likely to be a considerable advance in prices, for they in the Aberdare Valley had not yet recovered from the very stupid strike of a few years ago. He was pleased they had called upon one so young as himself, and would do all he could to assist so useful an institution. (Hear, hear.)

Mr. GLASSBROOK also briefly responded. He was not a great speaker—he would rather sink a pit or put up an engine any day. (Hear, and laughter.) The great thing which they as colliers had to do was to get up the price as much as they could. (Much laughter.) He believed if they were all as much of one mind about getting up the price of coal as they were about the advantages of the Institute, they would do themselves a great deal of good. (Laughter.) He was much obliged to them for the manner in which they had drunk his health.

Mr. L. BROUGH then proposed "Prosperity to the Royal Institution of South Wales," with thanks to them for their kindness in allowing the Institute of Engineers the use of their admirable Theatre for the purpose of their meeting. The Royal Institution had the honour, which very few similar institutions enjoyed, of being under the especial patronage of Her Majesty. He hoped it would exist for generations, and that their children might long have its grand roof over their heads. (Applause.)

The MAYOR, as one of the members of the Royal Institution, acknowledged the toast. The Royal Institution had had the steady support of the Corporation of Swansea from its commencement; they were the original owners of the ground on which it stood, and had given it to the trustees at a pepper-corn rent. (Hear, hear.) He thought it was only due to those gentlemen to say that it possessed a valuable library of reference, and an excellent museum of geological and metallurgical specimens, and that he believed it really did what it professes to do, and was, as it claimed to be, an institute not for the benefit of Swansea only but of South Wales generally. (Hear, hear.)

Mr. BASSETT said the next toast was the "Government Inspectors of Mines," coupled with the names of Thomas Evans and Mr. Lionel Brough.

Mr. EVANS, in responding, said that both Mr. Brough and himself had joined the Institute of Engineers as a matter of duty; and so long as it remained what it was they would, he was sure, do all they could to further its interests.

Mr. BROUGH also returned thanks. He observed that the appointment of mining inspectors—although the duties which they had to perform were frequently of an unpleasant character,—betokened a proper feeling on the part of the Government, as it arose from a desire to save human life. (Hear, hear.) He thought that the Inspectors generally had shown a desire to carry out the important duties entrusted to them in such a way as should give the least possible offence to the parties with and against whom they were called to act. (Hear, hear.)

The CHAIRMAN then proposed the "Press," coupled with the names of Mr. J. H. Jenkins, of the *Cambrian*, and Mr. M. T. Home, of the *Herald*, who briefly responded, which closed the proceedings.

THE ASSOCIATION FOR THE PREVENTION OF STEAM-BOILER EXPLOSIONS.—At the last monthly meeting of the executive committee, held at the offices, Corporation-street, Manchester, on Tuesday,—Mr. W. Fairbairn, F.R.S., in the chair, Mr. L. E. Fletcher, chief engineer, presented his report, of which the following is an abstract:—"During the past month there have been examined 319 engines and 471 boilers. Of the latter, three have been examined specially, four internally, 49 thoroughly, and 415 externally; in addition to which, one of these boilers has been tested by hydraulic pressure. The following defects have been found in the boilers examined:—Fracture, 5 (two dangerous); corrosion, 16; safety-valves out of order, 2; water-gauges ditto, 20 (one dangerous); pressure-gauges ditto, 10; feed apparatus ditto, 2 (one dangerous); blow-out apparatus, ditto, 14; fusible plugs ditto, 8; furnaces out of shape, 1: total, 78 (four dangerous). Boilers without glass water-gauges, 3; without blow-out apparatus, 21; without back pressure-valves, 17. Three boilers, not under the inspection of this association, have exploded during the past month, from which four persons have been killed and three others injured. One of the boilers has been personally examined since the explosion, while this was prevented in the other cases by distance. One explosion, by which one person was killed and two others injured, happened to an agricultural boiler, while at work at a farm, driving a threshing-machine. It was attributed entirely to a defective plate in the fire-box, which had been eaten away by corrosion until reduced to one-sixteenth of an inch in thickness. This plate had been previously repaired, and at the time of the explosion was cracked through, and though it had for some days been leaking in consequence, had yet been worked on in that state. The owner of the boiler was committed for manslaughter, the jury adding that they thought the appointment of a Government Inspector to be highly necessary. The third explosion occurred to a new balloon or haystack boiler, during the operation of testing, at the maker's yard. It had not been constructed for raising steam for purposes of power, but was intended to be used as chemical evaporating pan or still. The boiler was laid upon its side during the test, and gave way at the bottom, which was blown out entire, and thrown upon a roof about 10 ft. high, and 13 yards distant, the shell rearing up on its dome end, and remaining in that position supported by a shear leg. The rent between the bottom and sides of the boiler had occurred, for the most part, at the lower ring seam of rivets in the cylindrical portion of the shell, but not altogether so, some portion of the rent running through the rivet-holes at the outer edge of the circular bottom plate; while, from the upward position in which the latter was thrown by the explosion, it appeared most probable that the rent had commenced at that part of the boiler which lay nearest the ground at the time of the explosion, and thus, from the position of the fractures, must have started at the cylindrical part, and not at the bottom plate. The reason of this is not very apparent. It was ascribed at the inquest, by a scientific witness, to the simple fact of the plate having been in use before, it being stated that the tenacity of such plates is found to be destroyed, their fibre being changed, and rendered crystalline. It appears to me that we should pause before applying a questionable theory in the present instance. It is true that old boilers are not generally as trustworthy as new ones, but that is on account of the reduction in the thickness, from wear and corrosion, an impoverishment rather of quantity than of quality, and not the 'fatigue' of the metal itself, which does not commence till the limit of elasticity is passed. There are boilers working under the inspection of the association which are upwards of forty years old. Whatever may have been the cause that started the rent, one thing is certain—that the application of the hydraulic test would have detected and exposed the weakness, and prevented the explosion. It is, therefore, again earnestly recommended that in all similar cases this precaution should be adopted; and it is trusted that it will not be necessary for any further additions to be made to the list of fatal explosions—already sadly too long—before the adoption of the simple and inexpensive hydraulic test becomes universal.

MANUFACTURE OF WHITE LEAD.—Among the papers read before the chemical section at the recent meeting of the British Association at Newcastle, we have also to notice one which, from its title, "On Molecular Motion," by Mr. D. Zenner, of Newcastle-on-Tyne (of rotating buddle renown), would suggest itself to be of purely scientific interest, but which is, nevertheless, the result of observations on a practical subject connected with metallurgy. We shall omit the purely theoretical part of typifying the different phenomena of the motion of molecules, as being foreign to the Journal, but proceed to extract the substance. Mr. Zenner has observed that in the manufacture of white lead by the Dutch process, when the lead used in thin sheets is not of the best kind, there are observable several layers, distinguishable from one another by the different shades of colour, and which, moreover, may be separated. It naturally suggested itself to enquire into this remarkable phenomenon, and, on subjecting the different matters to analysis, he found that a motion of the impurities contained in the lead originally used, consisting of small quantities of copper, iron, nickel, and zinc, had left the outer crust of white lead, and concentrated mostly in a thin layer lying between the thick outer crust of carbonate of lead and the remaining part of the metallic lead which is left uncorroded in the middle of the "wicket." But, most remarkable, he further found, on submitting to analysis this remaining portion of metallic lead, that it had also absorbed a small part of the impurities rejected by the thicker crust of carbonate of lead, and he ascribes this absorption to a molecular motion within the solid metallic lead. He remarks that it was known among practical white lead makers that this uncorroded metallic portion of the lead is inferior to the lead first used, although nobody would have expected such an invasion of the impurities into the solid lead. We submit to our readers one sett of the analyses, which he laid before the meeting to establish the facts observed:—*a* is the analysis of the lead used.
b „ „ outer thick body of carbonate of lead produced.
c „ „ inner thin dark layer of carbonate of lead.
d „ „ metallic lead left in the inside uncorroded.

	a.	*b.*	*c.*	*d.*
Copper	·0047	·0035	·0086	·0079
Iron	·0027	·0018	·0076	·0050
Nickel and zinc	·0005	·0004 }		{ ·0008
Lead, for difference	99·9921	99·9943 }	99·9838	{ 99·9853

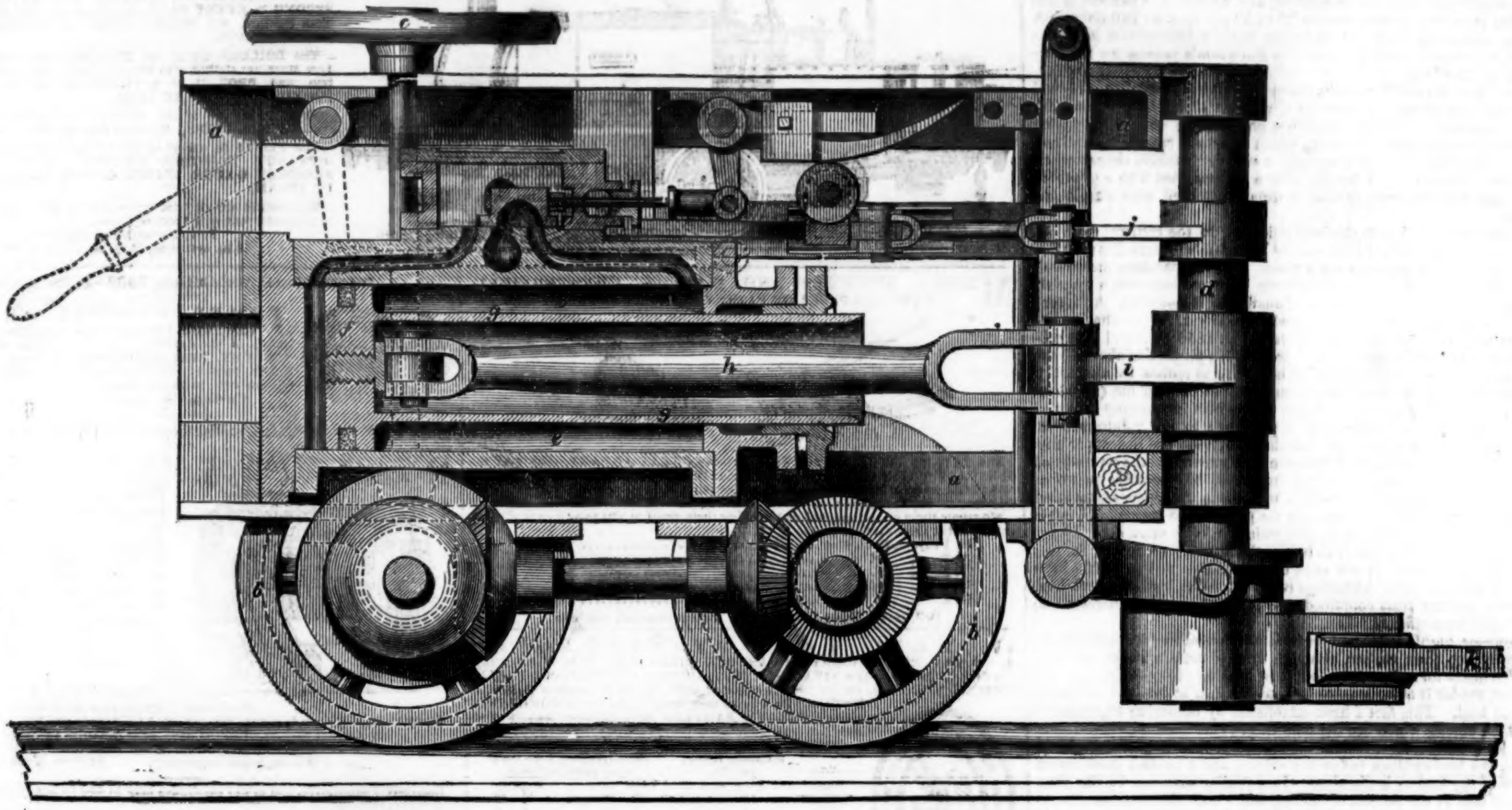
We have no doubt that the fact, being so far elucidated, will lead to some practical application.

MINERAL WEALTH OF MEXICO.—It is a well-known fact, corroborated by the highest possible authority (Baron Humboldt), that two-thirds of the silver ever in circulation, or upwards of $3,000,000,000, has been the produce of Mexican mines; and when it is considered that the mineral wealth of Mexico can scarcely be said to have been explored, and that the richest portions of the kingdom—Sonora, Sinaloa, and part of Chihuahua—still remain a *terra incognita*, we may almost be excused for indulging in a fear expressed many years back by Humboldt, that "should the mineral wealth of Mexico be ever thoroughly explored, Europe would be inundated with the precious metals." The average amount of silver annually exported during comparatively quiet times may be placed at about $20,000,000; that this might with ease be doubled or trebled no one the least acquainted with the country can doubt. Gold is known to exist in large quantities in Sonora, Chihuahua, and part of Guerero, but has never been worked to any extent. Copper mines of surprising richness exist in many parts of the country, but in the present defective state of land transport those only can be worked, with any prospect of success, which are near the coast.

GOLD IN NOVA SCOTIA.—A letter dated Sherbrooke, Sept. 10, says—"Slowly but surely the gold mining interest is becoming of great importance in the province, and deserving of far more attention from capitalists at home and abroad than it is receiving, owing, perhaps, to the actual facts in regard to the returns on capital invested not being widely known. The following returns for Sherbrooke Mines and Wine Harbour may be relied on as strictly correct, and will contrast very favourably with any returns I remember to have met with from other countries, especially considering the facilities in this country for carrying on mining operations:—At Sherbrooke, the average number of men employed for eight months, ending August, was 104; yield of gold from the crushers, 2248 ozs. At Wine Harbour, the average number of men for eight months, ending August, was 151; and the yield of gold from the crushers 2246 ozs.; equal, at $18·75 per oz., to $1·33½ per day for every man employed at that place; and $1·63½ per day for every man employed at Sherbrooke Mines. Those returns, extending over three of the worst months in the year for mining operations, should offer sufficient inducement for the investment of a large amount of capital, especially when we consider the extent of the auriferous district at Sherbrooke. I can see no reason why a company employing 104 men—the average number for the last eight months—should not on land at present untried, but which is known to abound in gold-bearing leads, receive a return as large as the foregoing, providing they work under judicious management. The probability is that the richest spots are not yet discovered, as during the present season, owing to all the miners being profitably employed, there has been no prospecting done. The Sherbrooke leads are known to extend for miles west of Goldenville, but as there is no road, and the whole surface is covered with a thick growth of brushwood, prospecting is very difficult. A road from Goldenville extending through to meet the shore road at Beaver Harbour, tapping the harbours of Liscomb and Marie Joseph, would be a great boon to those settlements; and as it would for its whole distance run parallel with the quartz reefs—in fact, follow very near the centre of the auriferous district—we might reasonably expect some rich discoveries of the precious metal."

QUARTZ CRUSHING.—It is now a generally-conceded fact that by the wet method of crushing quartz a large proportion of the gold is carried off from the batteries, and away from the mill, in the first rush of the water employed to discharge the sands through the sieves. Gold is capable of such minute divisions, and is so easily separated, that all must concede that in the violent abrasion to which it is subjected in the battery its particles, as they occur in the quartz, must necessarily lose much of their weight, by parting with numerous atoms, so infinitessimally small that the slightest current of water must inevitably carry them off. We will illustrate again, as we have already done in a previous number:—A piece of gold, especially if it be pure, drawn across even so soft a substance as a piece of bone, leaves a well-defined yellow mark. This mark, of course, is made of particles of gold which have been abraded by the contact of the two substances. It is often the case that gold is found through the entire mass of rock in particles no larger than those which form this graphitic-like mark. Such, no doubt, is the character of the gold found at the Mission, near this city. A moment's reflection, with this little experiment in mind, can scarcely fail to astonish any quartz miner, who has never had his attention particularly called to the matter before, at the large percentage of loss which must occur in a battery where many thousands of particles of intermingled gold are for hours and days subjected to the terrible abrasion of 800-pound stamps continually falling upon a mass of angular fragments of hard quartz. Of course, a large percentage of the gold mingled with quartz must be reduced to particles quite as minute as those contained in the supposed yellow mark upon the bone above alluded to, all of which must inevitably be carried off by the water necessarily passing through the battery during the process of wet crushing. Indeed, this finely divided gold will float upon the surface of the water for a month, even when it is slightly agitated, without becoming wet on its upper surfaces, and, of course, without sinking. Another great loss by wet crushing arises from the fact that no sieves can be made available with holes sufficiently fine to retain the quartz in the battery until it is reduced to a proper fineness for liberating all the gold which it contains. Hundreds of distinct particles of gold may be contained in a piece of quartz no larger than a pin's head, a large portion of which might be separated and saved by proper machinery, but never by any machinery where wet crushing is employed. The facts above stated have for years been gradually impressing themselves upon our quartz operators, until the losses sustained by the processes at present in use have come to be looked upon as a matter for the most serious investigation. Dry crushing, in the first instance, is the only conceivable remedy for the losses alluded to. Of the various processes for amalgamating there are several in use which might be advantageously employed. The matter at present under review is crushing—wet and dry. As already intimated, the evidences of the losses from wet crushing have long challenged the attention of quartz men, and various expedients have been resorted to to render practical some process of dry crushing. The ordinary straight and round batteries have been tried, with sieves boxed up to prevent the dust from rising. A very ingenious machine for dry crushing was introduced to notice last winter, known as "Pond's Crusher." Howell's centrifugal crusher has also been thoroughly tested at the Pike's Peak Mines; but the latest improvement in the way of dry crushing is a machine recently patented by Messrs. Wheeler and Hotalling, which may now be seen in operation at the Miners' Foundry in this city, and which we will now attempt to describe as well as it may be done without illustrations:—This machine, in the first place, comprises an ordinary battery, without sieves, boxed up closely. In the rear of the battery, and some 6 feet distant, is a large chamber some 10 feet square. Two or more tubes or pipes start from the upper interior space within the battery, and unite upon the outside, as near as may be to the same, and extend into the lower portion of the chamber aforesaid. About midway of this tube is a small chamber, in which is placed an exhaust fan, which when in operation produces a strong exhaust current of air from the interior of the battery to the interior of the chamber. As a matter of course the quartz as fast as it is thoroughly pulverised, rises in the form of dust, is drawn through the tube, and deposited in the chamber in the rear. The fineness of the dust is regulated entirely by the force of the exhaust draft, which may be easily regulated by a sliding tube or the speed of the fan. This current is kept up and aided by a return flue, of much larger dimensions, from the top of the chamber to the lower portion of the battery; the return flue taking the air from a point in the chamber as far removed as possible from the point where the dust is received from the battery. Actual working shows that very little is returned to the battery by the return current of air. This machine is but an experiment, yet a most flattering one thus far. We are not yet able to determine the quantity of work which it will perform. Of course, the wear and tear can be no more than that of an ordinary battery. Our impression from what we have seen is that the battery now in use—four stamps of 500 lbs. each—can reduce about 2 tons of rock, delivered to the battery dry, in twelve hours. The rock delivered from the machine is reduced to a fine dust, exhibiting but a mere grit when tried between the fingers dry. We have at our office a sample of the dust, which we took up at the mill, from a large mass, as a fair sample of the whole. Important improvements are already in contemplation. The experiment is in the hands of parties who have had large experience in quartz mining, and who will spare no efforts in bringing it to perfection. Quartz miners and others interested will do well to examine and judge for themselves. The machinery has been at work upon rock from the quartz mines back of the Mission, in this city.—*San Francisco Mining and Scientific Press.*

MESSRS. RIDLEY AND JONES'S TRUNK COAL CUTTING MACHINE.



The panacea for all difficulties in the labour market has been emigration. The landed proprietors, in order to get rid of a momentary taxation, have been among the first to encourage the wholesale emigration from this country. No one can complain of that. Our mechanics and skilled artizans were the first to seek new homes in distant lands; now our agricultural labourers are following in their steps; the stream of emigration has now become general. From Ireland, South Wales, and, in fact, from every other part of the United Kingdom, there is scarcely a family throughout the length and breadth of the British isles that has not either a relation or a friend firmly established in the colonies, or have become citizens of other nations, to which they continually invite other members of their families and friends to come and share their prosperity. Consequently, when our labouring classes make up their mind to emigrate, no matter whether to the Northern States of America, Canada, Australia, the Cape, or other parts, when they arrive at their destination they find friends to receive them, and homes already provided. Again, new countries are almost daily opening up. The scientific pioneer goes first, and points out the resources of the country; then follows the skilled labourer, with his pick and shovel, as the first settler. The hard labour he has experienced throughout his life in the Old Country gives him such confidence that he knows not what a difficulty means. The first family settled in the new country soon makes room for a second, the second for the third; villages spring up, then towns; the merchant joins in with his capital, and gets ample cargoes for his ships. Outward he carries the manufactures of England, and on the homeward voyage the raw materials for the English manufacturer. The new colony is complete, the foundation of a new empire laid, over which floats the flag of England, and under its protection peace, order, and prosperity reign, and another market is opened for the English labourer and mechanic. A German gentleman once remarked to me—"I found some valuable iron mines on my estate; I was anxious to turn them to account, and with that view I went to Staffordshire, and engaged two of your practical workmen. When they arrived in Germany, my friends, and some of our learned men, explained the difficulties of coming to such a work. The two Englishmen, to our astonishment, simply replied, 'If you will put some men in that quarry to dress the stone, and get some fire-bricks, we will soon erect you blast-furnaces, and make you some good iron.' My impression at the time was, that if this was the way the English go to work in a new country, no wonder England is 'the mother of so many nations.' I followed their advice, and, like those men, determined henceforward to see no difficulties, and my works are doing well."

But it now becomes a question, with so many new markets open for English labour, can England meet this labour demand on her resources? Some few years ago two workmen were running after one master for employment; things are now changed—two masters are running after one man. The iron manufacturers now find this to be a fact, and have increased the price of that article 1*l.* per ton to meet the demands of their workmen. One ironmaster stated, "I dare no longer tamper with my men, or I shall lose them all." The same cry comes from the agricultural districts; the labourers demand more wages, and the price of agricultural produce is greatly on the increase. Some of our political economists attribute the high price of provisions to the influx of gold, and the depreciation in the value of that precious metal. This is not the case, it is Labour *v.* Gold, and labour has carried the day. The reason of all this is very obvious to the thinking mind: for the last few years there has been a great competition in the coal and iron trade, the prices have been run down to the lowest ebb, and with it the rate of the workman's wages. The workman, finding things in this state, sells his few goods and chattels, and emigrates, leaving the capitalist to his own resources. What is the result? The manufacturer is now placed between two fires—competition and labour; the latter has gained the victory, and will keep its ground; emigration will be the workmen's safety-valve for the future. From the numerous outlets for the English workman, it is not too much to expect that ere long labour will say to capital, "Those are my terms, whether you employ me or not." Capital must then fight its own battle in the best way it can. Observing men see this, and hence the great demand for machinery to supersede manual labour. Well, this is a step in the right direction. Machinery is the manufacturers' ground of hope for continued prosperity; therefore, every new machine for superseding manual labour will, or ought to be, gladly accepted as an additional means of commercial safety, and those who neglect machinery will soon find it out to their cost. A few weeks ago allusion was made to the new coal-cutting machine, invented by Messrs. Ridley and Jones, of which the above is an illustration. The diagram shows a sectional elevation of one of their arrangements, in which the "trunk engine" is combined with a lever pick: *a* is the framing of the machine; *b b* are the wheels upon which the machine travels; *c* is a hand-wheel for moving the machine along as the work progresses; *d* is an upright axis, at the lower end of which there is a socket to receive a lever pick. All these parts may be constructed as heretofore, or may be varied as circumstances require, but in place of using the class of engine heretofore employed, they use what is known as a trunk engine: *e* is the cylinder, *f* the piston; *g* the trunk, which they prefer to make in one piece with the piston; *h* connecting-rod, one end of which is attached by a pin-joint to the piston, or inner end of the trunk, and the other end to a lever (*i*) fixed on the upright axis (*d*), by which motion is communicated to the pick. The slide valve is worked by a lever (*j*) on the axis (*d*), as shown. It will readily be seen that by attaching the connecting-rod to the piston the machine is considerably shortened, thereby rendering it more portable, and easy to move round the shortest bends in the tramways of mines, and by causing the compressed air to act on the larger area of the piston to strike the blow, and on the smaller area to bring the pick back, much of the compressed air heretofore used will be saved. When working with a sliding pick a similar truck or carriage and a like air-engine are combined, but the connecting-rod in the trunk of the engine is at its outer end pin-jointed to another connecting-rod, or lever, the other end of which is pin-jointed to a link, which is pin-jointed to the sliding pick. The pick slides to and fro in suitable guides, fixed near the end of the truck, or carriage; in this arrangement also the pressure of the compressed air to bring the pick back acts on the smaller area of the piston.

Hitherto, in our collieries and iron mines, the use of steam and other machinery has been confined to simply raising the coal and other minerals, and pumping the water out of the works; but here we have a machine capable of doing the work of at least 25 men per day. It is the most compact "iron collier" ever invented, and for the purpose intended it is most complete. This machine is only 27 in. high, 14 in. wide, and 36 in. in length. It runs, as will be seen in the above illustration, on four wheels, on a pit tramway 14 in. wide. It weighs only 10 cwts.; the cylinder is only 6 in. in diameter, and the engine is constructed on the single trunk principle, and is driven by compressed air, and strikes 100 blows per minute. Under the guidance of one man, it moves backwards and forwards at pleasure, and under the most perfect control. From the force of its blow, it will either crack a nut or shiver a massive rock to atoms.

It has been already stated in the Journal that this machine is capable of undercutting the coal from 3 to 4 ft. in depth, and 150 yards in length, in about eight hours. About three of these machines in a colliery would liberate from 300 to 400 tons of coal per day, according to the thickness of the seam, and do the work of at least 250 men. So admirable and compact are all its details, that a common colliery blacksmith can repair almost every part of it in case of breakage. As to the commercial advantages of the machine, if we assume it will undercut 150 yards of coal in eight hours, while a collier only undercuts six yards of coal per day for 3s.; the difference, therefore, is greatly in favour of the "iron colliers." If a colliery can be worked with the same efficiency by the machine, and with 100 to 200 less men, there must be a great saving in expense of safety-lamps and other materials consumed by the workmen, and less chance of strikes among the workmen. Again, in case of an explosion in the colliery, the loss of life would be small indeed compared to what it is at present, with a pit crowded with colliers. In addition to this, from the low price at which the coal could be cut, colliery owners would scarcely feel the expense of keeping up an effective system of air-courses through their works, and these fearful explosions would be greatly diminished.

So far as the collier is concerned, he will receive the greatest benefit from the introduction of coal-cutting machinery; from being the "slave to the pick" he is at present, he will rise in the scale of humanity, and earn his money with less labour and fatigue. Workmen of all classes are more or less prejudiced against machinery, but it is only so until they understand it, and find it has lessened their labours and greatly added to their comforts; when they find out this result, they invariably speak of the machinery under their control with pride, and keep it as bright and clean as if it were more for ornamental than for useful purposes.

For collieries worked on the long wall system this machine is all that can be desired. As soon as the coals are sent out, the machine undercuts the face again for a fresh fall of coal; and each man in the colliery follows after it in his respective employment, the machine doing all the colliery drudgery work. The time will now soon come when an iron collier, to fill the coals, will also be introduced. The air is said to be full of invention to lighten the labours of man; and one by one these inventions will fall to the earth, for the well-being of all classes.

The ironmasters have been the first to feel the effect of the late depression in the iron trade; from the low rate of wages they have lost their best hands; these are now employed in the mills and forges in America, and in the gold fields of Australia. The late victory of the workmen in the iron manufacturing districts will rapidly extend to other trades; each one will have its crisis, and unless they meet the demands of the workmen in the same spirit as the ironmasters have done, the workmen will emigrate, and the skill of their best hands will in other countries be turned into competition against the English manufacturers; therefore, if the English panacea in times of commercial depression is emigration, the panacea for excessive emigration in England is the introduction of machinery to supersede manual labour; and Messrs. Ridley and Jones's coal-cutting machine, as before stated, is a step in the right direction. The invention now only awaits the patronage of our coal and ironmasters.

OBTAINING PRODUCTS FROM COAL.—Some improvements in the treatment of coal tar, dead oils, and in producing phenic or carbolic acid, have been patented for Mr. J. J. Müller, of Basle, Switzerland. The invention relates to the process of treating with lime the heavy oils obtained from coal tar. There is a great difficulty in obtaining a satisfactory result from this process, unless the right proportions are taken to produce a homogeneous mass of phenate of lime. It has, in fact, been considered practically impossible to treat the heavy oils with lime in the same way that they are treated with caustic potash, or soda, and for that reason it is considered that the present invention offers great economy over the old process. The dead oil is allowed to stand for a few weeks until the naphthaline has become separated by crystallisation. Of the oil thus prepared take 100 kilogrammes, and mix therewith in a suitable vessel from about 6 to 7 kilogrammes of milk of lime, the milk of lime being made in the proportion of 2 kilogrammes of lime to 15 kilogrammes of water. This mixture is to be kept well stirred until the lime is quite dissolved, and it is then allowed to rest for from two to three days. A phenate of lime is thus obtained, which, by reason of its specific gravity settles at the bottom of the vessel, is then to be decanted from the light oils. The solution of phenate of lime being clear is now placed in a suitable vessel and saturated by an acid in the way that is now generally practised. It is preferred to use muriatic acid, which combines with the lime, forming therewith a soluble salt. The phenic acid thus obtained, which is easily separated from the muriate of lime by decantation, is distilled over for purification. A second distillation will produce crystallised phenic acid. It should be remarked that it is very important to use the dead oils as free as possible from napthaline, and that for this reason the napthaline is removed, as above explained, before applying the milk of lime.

ON THE IMPURITIES CONTAINED IN LEAD, AND THEIR INFLUENCE ON ITS TECHNICAL USES.

BY WILLIAM BAKER, ASSOCIATE OF THE ROYAL SCHOOL OF MINES, F.C.S.

The methods employed in this country for smelting lead from its ore are now almost entirely confined to the treatment of the crushed galena in a reverberatory furnace without any previous calcination. In some places the Scotch ore-hearth still exists, when a blast of air is used in the reduction. In all cases the rich slags from the reducing furnaces are smelted either in the slag hearth or in the Castilian furnace, both of which are also worked with a blast. In the Castilian furnace poor ores are reduced along with the slags. The pig-lead, as it is delivered to the manufacturers from these operations, is easily distinguished by its physical characters—and is known either as *soft* or *hard* lead. That which is smelted from an average good ore in the reverberatory furnace is always soft, and fit for rolling or making into pipes. That which is smelted by the aid of a blast at a high temperature, even if the same ore is employed, is invariably hard. Of course, there are different degrees of these qualities, but the distinction is marked between these two classes of lead.

The characters by which pure lead is known are its softness and malleability—its appearance when melted, and its surface when poured out into a mould. Pure lead rolls without cracking at the edges; when melted and skimmed at a low temperature it is white, and possesses a smooth mirror-like surface; and at a higher temperature the succession of colours produced by oxidation is by no means so variegated as in lead containing certain impurities. The surface of an ingot presents a confused and interlacing mass of arborescent or fern-like crystals, which impart an unevenness at the moment of solidification. A pig of such lead, when broken (which may be done by carefully heating to a little below the melting point), presents a white fracture, which is largely but irregularly columnar. These forms are due to the interference of the groupings of crystals, the lines not being themselves edges of crystals. I lay some stress on the whiteness of the surface, and of the fracture of pure lead, because many common qualities of lead present also a white appearance, which is, however, due to the presence of certain impurities, and may be as easily distinguished as the whiteness of silver can be from that of pewter.

Such being the characteristics of pure lead, it is natural to enquire what are the impurities which render it hard, and what elements may exist in it without impairing the qualities which render it suitable for its various technical uses. The substances which commonly impart hardness to lead are sulphur, antimony, and arsenic. Copper, if alone, does not much affect the softness of lead; nor is iron, in the absence of sulphur, found in sufficient quantity to produce hardness. Ordinary soft lead generally contains from ·008 to ·010 per cent. of iron, but both iron and copper may be introduced to a considerable amount in the form of sulphides, in which case they, as well as the sulphur, impart hardness to the metal. At a high temperature several metallic elements, in combination with sulphur, will melt, become diffused in the lead, and render it hard. Phosphorus, or phosphide of lead, will not exist in the metal, for when phosphate of lead is reduced in a close vessel, phosphorus may be distilled off, and the lead obtained quite pure and soft. At a low temperature only a trace of sulphur or sulphide of lead will remain diffused in the lead; but if the temperature is increased, so much sulphide may be melted and diffused in lead as to render it decidedly hard. This explains why pure galena, smelted by a blast, will give a hard lead. On re-melting at a low temperature the bulk of the sulphide is removed, and what remains may be shown to be unequally diffused in the metal; for, if such a piece of lead be corroded, as in the process of making white lead, irregular particles of a dark colour may be seen in the mass of white carbonate.

In the process of oxidation of lead for making red lead it has been the custom to add a pig of hard, or slag, lead to the charge for the purpose of promoting the oxidation. I have melted together pure galena and lead in the proportion of 2 per cent. of the sulphide, and produced a hard lead, which answered the purpose quite as well as the slag lead usually employed.

Antimony, tin, and zinc imparts a whiteness to lead, each peculiar to itself. Zinc is, however, seldom found in lead, and tin exists in but small quantities: antimony is the chief element which, with sulphur or alone, gives the characteristic hardness and whiteness to slag lead. At the high temperature of the blast-furnace, therefore, we may have sulphides of antimony, copper, iron, and arsenic diffused in the lead as it is reduced and runs down into the kettle. Such is the hard lead which must be specially treated before it can be used in the arts.

Refining processes for impure lead are essentially oxidising processes. When the amount of antimony is not more than 1 to 2 per cent., as in Derbyshire slag lead, the pigs are placed on the bed of the ordinary reducing furnace, and melted down with free access of air. This is really a liquation as well as an oxidising process; the separation of the lead from its impurities being effected by taking advantage of the difference between the melting points of lead and the mixed sulphides—the latter being left on the bed of the furnace, whilst the purified lead in an oxidising atmosphere runs into the pot. I have introduced an oxidising agent for effecting the softening of slag lead as it is tapped from the blast-furnace. If nitrate of soda be stirred into the lead whilst kept at a heat just below redness, the sulphides are immediately attacked, and, instead of the white smooth surface it first possessed, a play of irridescent colours and a wrinkled surface disclose the characteristic appearances of ordinary soft lead. When a large quantity of antimony is present, as in most Spanish leads, the metal is

treated in an improving furnace, where it is calcined or subjected to an oxidising flame for a length of time varying with the hardness of the lead. The rich antimonial slags are re-smelted, and ultimately a product is obtained from them which may contain 20 to 30 per cent. of antimony. A method of separating lead and antimony is yet a desideratum in metallurgy.—The softened lead is treated by Pattinson's process for the concentration of the silver.

Softened lead may still contain traces of antimony, sulphur, tin, and iron, and yet a more notable quantity of copper. If free from tin and antimony, it gives a fine display of colours on melting; and on increasing the temperature the film of litharge which is formed cracks in all directions, showing when the lead is agitated a wrinkled surface, characteristic of soft lead. Softened lead breaks with a *fibrous*, not with a granular, fracture, and the fractured surface is usually coloured with purple and blue tints.

We have now to deal with the impurities left in the softened lead. It is in the operation of desilverising lead by Pattinson's process that a further elimination of foreign elements takes place. Upon separating the crystals from the fluid alloy, I find that when we have to deal with a properly softened metal, the trace of iron remains unaffected in quantity. Antimony appears to become concentrated along with the silver, but to what extent remains to be proved by a series of analyses. In 1856 I showed that copper also is found with the silver; but if present in a proportion above 10 ozs. per ton, eight or ten operations will be necessary to reduce its amount to a trace; and when it is present to the amount of 20 ozs. per ton (=·06 per cent.), six crystallising operations failed to diminish its quantity in the refined lead. Reich, in a communication published in the "Jahrbuch für den Berg-und Hüttenmann, 1860," has shown that most of the copper goes with the dross, which is removed from the lead previous to the crystallising operation. But this is only true when the copper is in notable quantities as sulphide. In the experiments which he adduces, the copper seems never to be reduced beyond ·10 per cent. At the point Reich leaves off I begin —not considering that lead to be soft which contains more than ·10 per cent. To prove if it be possible to reduce the amount of copper in this manner, lead containing ·05 per cent. of copper was melted with a little pure galena, and the pasty skimmings removed. The lead still contained ·05 per cent., and the dross contained ·048 per cent.; so that, therefore, no separation had been effected.

It is, however, highly important for certain technical uses that lead should be practically free from copper, although it may contain 20 ozs. per ton, without detriment for rolling into sheets and making pipes—2 ozs. per ton, or even less, render it objectionable for making into white lead or glass-makers' red lead. This fact I have established by numerous experiments and analyses, among which are the following:—

When lead containing a certain amount of copper is placed in dilute nitric acid, the lead oxidises before the copper, and a reddish moss covers the surface of the lead as it dissolves. In a similar manner, by the slow oxidation of lead in the process of making white lead, the particles of copper, or suboxide, are carried and locked up in the corrosion, imparting in some cases a delicate pink tint to the carbonate of lead. In a bed of corroded lead, all cast out of the same pan, a portion will exhibit a pink colour, whilst another is white. The appearance of the pink colour, therefore, is influenced by the position of the lead on the bed. Closer observation will discover that where the current of vapours arising from the fermenting tan is copious, the pink colour disappears. Where the corrosions are swelled and flowery—in a word, where the air has access more freely —there is no pink colour. But in these cases there is then often visible the blue, or greenish-blue, tints of carbonate of copper. Synthetical experiments have also established this fact. Pure lead corroded in various parts of different beds invariably give pure white corrosions. Upon adding a small quantity of copper, and submitting it to the corroding action, pink passing into blue was distinctly visible. It is worthy of notice that the pink colour is generally more striking, close to the metallic lead. The blue colour appears on the outside, or where lines of weakness have been formed by alternation of temperature, which cause the corrosion sometimes to separate in layers, thus allowing the air to penetrate.

A portion of pink corrosion suspended in a flask containing a little acetic acid gradually loses its colour, which passes into faint blue, and sometimes disappears, leaving the corrosion disintegrated and more swelled, but white. It is remarkable that the purest tint of pink is obtained with very small quantities of copper. Thus, 2 ozs. per ton gives a more decided colour than 10 or 12 ozs. per ton. The pink colour may be masked by the presence of sulphur or antimony.

A manufacturing test of the truth of these statements has been made. Common slag lead softened, refined, and having the copper eliminated by a special process, produced a lead which cannot be distinguished from the most pure white corrosions. Before the removal of the copper the lead gave decided pink corrosions. The red lead which is used for glass making should also be practically free from copper. An almost inconceivably small amount imparts a blue tint to glass. For a long time the Snailbeach lead has been reputed for glass making, and it was only after making arrangements for eliminating the copper in the manufacturing processes that lead which contained at the commencement from 5 to 8 ozs. per ton could be used with equally good results. Good red lead for this purpose should not contain more than 1 oz. per ton.

—*Mining and Smelting Magazine.*

Ozone.—The subject of ozone is probably of sufficient importance to justify my troubling you with one or two facts respecting it, which eight years' observations with Schönbein's test-papers enable me to furnish. The fact to which I wish to call particular attention is, that the wind which has recently come over the sea invariably, or almost invariably, brings with it a large amount of ozone, while a land breeze usually yields but a small amount. A strong west-south-west wind here is always charged with a large quantity of ozone, while other winds are generally but slightly charged with it, and such as have passed directly over the city of Bristol are altogether free from it. A recent visit to Sidmouth, on the south coast, has quite confirmed my previous notions in regard to sea breezes and ozone, and I may mention that a correspondent in New Zealand, to whom I sent some test-papers, assures me that he has obtained similar results in that island. Facts such as these, now satisfactorily proved, may help us in our endeavours to ascertain the truth in reference to this rather mysterious agent, which, in addition to its interesting nature in a meteorological point of view, is generally considered as of importance in regard to health.—William C. Burder: *Clifton, Sept. 26.*

California Copper Smelting Works.—Mr. Ralph Emerson, the secretary of the company, has furnished to the *Mining and Scientific Press* of San Francisco the following particulars as to the rates and terms on which the company are now purchasing ores:—Ores assaying from 8 to 11 per cent. are purchased at the rate of $2 per unit; ores assaying 12 per cent. at $25 per ton; 13 per cent., $27·25 per ton; 14 per cent., $30 per ton; 15 per cent., $32·50 per ton. A ton is received at 2376 lbs., to be delivered at the company's works at Antioch. Shipments may be made in bags or in bulk. If in bags they will be returned. The land and water freight will be advanced by the company, on delivery of ores at the works, and payment made as soon as a satisfactory assay shall have been obtained. The California Smelting Works propose to buy their ores upon a different scale from that applied by other purchasers in this city. When ores are shipped east, or to Europe, the nett assay is taken, but from 1 to 2 per cent. is deducted, and upon that produce the advance is made, and not upon the real per centage as contained in the ore; but the California Smelting Company propose to buy upon the true amount in the ore. To illustrate, from ore that will assay (say) 14 per cent., any other parties here advancing would deduct 1¼ per cent., at least, and call it 12¾. The company will not confine itself to the purchase of ores of low assay. Contracts will be made for all the ores a mine may produce, and the higher the assay the greater will be the price per cent.; but it is obviously to the advantage of copper miners to sell their inferior ores to the Smelting Works, since they cannot be profitably shipped to a foreign market, and the expense of concentration, and the loss of metal attending on that process, will counterbalance any advantage obtained in economy of transportation when concentrated. Additional furnaces will be built, and due capacity of the works will be made to keep pace with the supply of ores.

A Site for Ironworks.—We should imagine that no better site for ironworks could be found than on Bowes Moor, near Barnard Castle. The Auckland coal field is within an easy distance, with every facility of railway communication; and any quantity of limestone could be procured on the spot. Iron ore, from either Lancashire or Cleveland, could be delivered by rail at the works, and Bowes Moor itself is not destitute of ironstone. The same railways which would bring the raw material would also be available in conveying the manufactured iron to market. There is waste and for the deposit of the slag or scoria for ages to come. A site like this, though overlooked as yet, cannot be much longer neglected; and we feel assured that, before many years elapse, the manufacture of iron will be busily carried out in this now quiet locality.—*Teesdale Mercury.*

More Blast-Furnaces.—There are now being erected seven new blast-furnaces—four at Eston, by Messrs. Bolckow and Vaughan; and three at Newport, by Messrs. Samuelson and Co. Messrs. Gilkes, Wilson, and Co. are preparing to build two more adjoining their works; and Messrs. Hopkins and Lloyd are prepared to erect three between Stockton and Newport. Messrs. Dunning and Co. are going to put up two additional furnaces adjoining their present ones. There are also two others in contemplation. This will make 16 more blast furnaces for the Cleveland district. Messrs. Head and Co., from London, have purchased land at Newport, on which to erect rolling mills. The iron trade of this neighbourhood is in a most flourishing condition; orders are taken away stocks as fast as they can be made, at advanced prices, both of pig and wrought-iron. The prospect for the coming winter is most favourable.—*Stockton and Hartlepool Mercury.*

Thames Tunnel Company.—Receipts for the week ending Sept. 26, 64*l.* 12*s.* 5*d.*; number of passengers, 15,509.

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